Site Review And Update

TORCH LAKE

HUBBELL, HOUGHTON COUNTY, MICHIGAN

CERCLIS NO. MID980901946

MAY 25, 1995

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Site Review and Update: A Note of Explanation

The purpose of the Site Review and Update is to discuss the current status of a hazardous waste site and to identify future ATSDR activities planned for the site. The SRU is generally reserved to update activities for those sites for which public health assessments have been previously prepared (it is not intended to be an addendum to a public health assessment). The SRU, in conjunction with the ATSDR Site Ranking Scheme, will be used to determine relative priorities for future ATSDR public health actions.

SITE REVIEW AND UPDATE

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HUBBELL, HOUGHTON COUNTY, MICHIGAN

CERCLIS NO. MID980901946

prepared by

Michigan Department of Public Health (MDPH)
Under a Cooperative Agreement with
Agency for Toxic Substances and Disease Registry (ATSDR)

SUMMARY OF BACKGROUND AND HISTORY

A. Site Description and History

Torch Lake is a 2,700 acre lake (maximum depth 105 feet) located in the Keweenaw Peninsula in the northern part of Michigan's Upper Peninsula. The lake is located approximately 8 miles east-northeast of Houghton, Michigan (Figure 1). Torch Lake discharges through Torch Bay to Portage Lake, which connects to Lake Superior through the Portage River and the Keweenaw Waterway. There are four small communities along the west shore of Torch Lake: Lake Linden, Hubbell, Tamarack City, and Mason.

Michigan's Keweenaw Peninsula is the site of large deposits of native metallic copper, which have been exploited since the first humans reached the area. By the 1860s, large-scale copper mining operations were underway on the Keweenaw Peninsula. By 1868, the first mill on Torch Lake for separating the metal from the rock was in operation. The mills, Reference 1 lists eight that were located on the western shore of the lake, separated the metal from the rock mechanically, by crushing or stamping and grinding to produce a fine gravel, then using flotation in water to gravimetrically separate the metal from the rock. The leftover rock, or tailings, still containing some copper that could not be recovered by the technique used, were discarded by disposal with the flotation water into the lake or other waterways. Mining and milling operations on the Keweenaw Peninsula peaked between 1900 and 1920. After approximately 1916, advances in technology allowed recovery of the copper in the tailings. The tailings were dredged up, treated with various chemicals, including cupric ammonium carbonate, lime, pyridine oil, coal-tar and wood creosotes, pine oil, and xanthates, the extracted copper removed by flotation, and the remaining tailings returned to the lake. Mining activity in the area decreased after 1920, though copper recovery from the tailings, in at least three of the mills, continued until 1968, when the last mill on Torch Lake closed. At least 200 million tons of tailings were discharged into Torch Lake during the century of milling operations on the lake, filling at least 20 percent of the original volume of the lake and causing drastic changes to the shoreline. Lake Linden and Tamarack City have constructed lagoons for sewage disposal on the tailings. Lake Linden also operates a public park with a campground, bathing beach, and boat launching ramp on or near the tailings at the north end of the lake. There is also an abandoned landfill on the tailings at the north end of the lake.

Vegetation on the tailings is generally sparse and shows signs of stress. There are a few areas, such as that around the public park mentioned above, where imported topsoil or sewage sludge has been spread in an attempt to establish vegetation. The sewage lagoons are fenced, the rest of the tailings are not (1).

Because of a high incidence of tumors in fish from the lake, in 1983 the Michigan Department of Public Health (MDPH) issued an advisory that no one should eat any walleye or sauger caught in Torch Lake. After further investigation found no sign that the tumors persist, in 1993 the MDPH removed the special advisory from Torch Lake. However, due

to wide-ranging elevated mercury content in fish from Michigan, Wisconsin, Minnesota, and Ontario, the MDPH has issued a general advisory covering all inland lakes, reservoirs, and impoundments in Michigan, including Torch Lake. This advisory reads:

> No one should eat more than one meal a week of fish of the following kinds and sizes from any of Michigan's inland lakes or reservoirs: rock bass, perch, or crappie over 9 inches in length; largemouth bass, smallmouth bass, walleye, northern pike, or muskie of any size. Nursing mothers, pregnant women, women who intend to have children, and children under age 15 should not eat more than one meal per month of the fish species listed above (2).

The Torch Lake site was placed on the United States Environmental Protection Agency (U.S. EPA) National Priorities List (NPL) on June 10, 1986. A Remedial Investigation/Feasibility Study (RI/FS) of the Torch Lake site was initiated by a contractor for the U.S. EPA in October 1988. For the RI/FS, the site was divided into three Operable Units (OUs). Operable Unit I includes the primary contaminant sources, surface tailings and drum contents on the western shore of Torch Lake. Operable Unit II includes other potentially contaminated environmental media in the vicinity of Torch Lake, the North Entry to the Keweenaw Waterway, and the northern portion of Portage Lake, including soil, air, surface water, submerged tailings, sediment, groundwater, and biota. Operable Unit III includes other tailings contaminant sources in the mid-Keweenaw Peninsula area (see Figure 1). The final report on the RI of Operable Unit I at the Torch Lake site was issued in November 1990 (1). The final reports on the RI for Operable Units II and III were issued in January 1992 (3, 4), with addenda to the RI for OU II circulated in March 1992 (5) and July 1992 (6).

In August and September 1991, a contractor for a group of Potentially Responsible Parties (PRPs) for the Torch Lake site located, excavated, and overpacked for removal to appropriate disposal sites 103 drums filled with waste from Torch Lake or neighboring land. Twenty of these drums were taken from the lake, 83 from land sites. Approximately 800 empty drums were also located in the lake, but were left in place (7).

In September 1992, the U.S. EPA signed a Record of Decision (ROD) for Operable Units I and III at the Torch Lake site. The ROD called for covering the tailings and slag piles with clay and a vegetation layer. Certain of the sections of OU III are to be left uncovered because their location exposes them to Lake Superior waves, which during storms would probably destroy any cover applied to the tailing and slag piles (8). Action to implement this ROD is planned to begin after the ROD for OU II is signed. As of May 17, 1994, the U.S. EPA and MDNR had concurred on a "No Action" ROD for OU II at the Torch Lake site (9).

B. Previous ATSDR Involvement

On April 14, 1989, the Michigan Department of Public Health (MDPH), working under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), prepared a Preliminary Health Assessment (PHA) for the Torch Lake site. The PHA concluded that "This site is of potential public health concern because of the risk to human health that could result from the possible exposure to presently unknown etiologic agents at the levels that may result in adverse health effects over time." The PHA included recommendations for further site investigation, specifically of the barrels that were found in the lake, private wells near the lake, and fish in the lake. The PHA also recommended that the abandoned buildings and industrial scrap materials on the lakeshore be cleaned up to reduce physical hazards. No health studies were recommended in the PHA, because the assessors had not found any indications that exposure had occurred (10).

On April 18, 1990, the MDPH prepared a consultation for the ATSDR in which they evaluated some soil, tailing, and air data provided by the U.S. EPA. The material analyzed was judged to pose no health threat (11).

CURRENT CONDITIONS OF SITE

A. Site Visit

On July 28, 1994, the MDPH assessors consulted via telephone with Dr. Kenneth Rowe, a retired State and local health department officer who lives in Calumet, Michigan, for current information regarding the Torch Lake site. He confirmed that there were no restrictions of access to the tailings areas along the lake. The tailings areas are pretty much vegetated, and blowing dust from the tailings was no longer the problem it had been in the past. He also confirmed that the Lake Linden park, campgrounds, and bathing beach were near or on one of the tailings areas. The beach sand is stamp sand from the copper mills. The majority of the mills have been torn down, but their sites have not been totally cleared of debris, foundations, and smoke stacks of the mills. There are still abandoned dredge structures in the lake. Some of the mills have been proposed for preservation or restoration as part of a proposed National Historic Park commemorating the copper industry in the area. One of the OU III mill sites, on Portage Lake east of Houghton, is under development as a residential community (12).

B. New Data on Environmental Contaminants and Other Hazards

During the Remedial Investigations for the three Operable Units for the Torch Lake site between 1989 and 1991, the contractors collected and analyzed samples of tailings from the shores of the lake and from nearby copper stamp mill sites; sediments and surface water from Torch Lake, the Keweenaw Waterway, and other nearby lakes; groundwater from the Torch Lake area including residential and municipal wells; surface soil from residential areas on Torch Lake; and air from the Torch Lake vicinity (1, 3, 4, 5, 6). In 1988, the MDNR

collected fish from Torch Lake to further investigate the tumors found in the lake, and as part of their Fish Contaminant Monitoring Program (13, 14). In 1990, under an Interagency Agreement with the U.S. EPA, researchers from the U.S. Fish and Wildlife Service and The Ohio State University investigated the effects of high concentrations of copper on the reproduction of yellow perch in Torch Lake (15). Drummed wastes found in and near Torch Lake were sampled for analysis in several rounds in 1989, 1990, and 1991, before the drums were removed for off-site disposal in August and September 1991 (1, 7). In July 1989, September through November 1990, and October 1991, various U.S. EPA contractors collected water samples from residential wells, community wells serving Lake Linden and Mason, and a Houghton municipal well near Torch Lake (1, 3, 16).

CURRENT ISSUES

A. Public Health Concerns

Surface material on the tailing piles and in residential areas near Torch Lake contain metals and PAHs at concentrations potentially of human health concern (Table 1, Table 2, Table 3). Access to the tailings and residential areas is not restricted. Residents and visitors are exposed to the chemicals in the surface material in the residential area, and people visiting the tailings area before the scheduled remediation occurs might be exposed to the chemicals in the surface materials. The concentrations found of PAHs are within background ranges for urban soils (Reference 17, Table 5-2). The concentrations of PAHs in the residential areas are higher than those found in the tailings areas, indicating that the presence of the chemicals may not be related to the site. PAHs are ubiquitous in the environment as products of incomplete combustion.

Water from monitoring wells in the tailings area of the Torch Lake site contained various metals at concentrations above ATSDR comparison values (Table 4). As shown in the Table, the concentrations in shallow wells, screened in the tailings, were generally higher than those in the deeper wells, screened below the tailings. Water samples from residential and municipal wells near Torch Lake have contained concentrations of arsenic, copper, DDD, DDT, lead, manganese, thallium, and vanadium at concentrations above ATSDR comparison values (Table 5). Of these, only copper and thallium exceeded U.S. EPA Maximum Contaminant Level Goals or other action levels (the MCLG for thallium is 0.5 ppb). The U.S. EPA has no action levels for DDD, DDT, manganese, or vanadium.[1] Normal well-drilling practice in the area, enforced by the state and local health departments, is for potable water wells to be drilled into the deeper bedrock aquifer. In addition, the groundwater gradient in the tailings area is towards the southeast, towards the lake and away

[1] The U.S. EPA has issued a Secondary Maximum Contaminant Level, based on non-health-related criteria, such as odor, taste, and color, of 50 ppb for manganese. The U.S. EPA had issued a Lifetime Health Advisory (LTHA) for Drinking Water of 20 ppb for vanadium, but the Agency has rescinded the LTHA.

from the most populated areas. The RI did not investigate the groundwater flow on the east side of Torch Lake, which is thinly populated. A Technical Assistance Team (TAT) investigation in July 1989, preparatory to the RI, collected water samples from three private wells on the northeast shore of Torch Lake. Of these samples, one contained 9.2 ppb lead and another contained 12 ppb vanadium. These were the only chemicals found at concentrations above comparison values. There was no evidence of site-related contamination reaching these wells. However, these wells are not directly downgradient from the tailings areas on the Torch Lake site. There is no record of private wells being sampled, or even that private wells exist, on the southeast shore of Torch Lake. now?

The fish collected from the lake in 1988 showed no increased incidence of tumors above that found in other bodies of water (13). Analyses of the fish for chemical contaminants found only mercury at concentrations above MDPH Levels of Concern (generally based on Action Levels used by the U.S. Food and Drug Administration) (Table 6) (14). The MDPH considers the mercury concentrations in Torch Lake fish to be consistent with the generic advisory on consumption of fish from any inland lake or reservoir in Michigan. The MDPH removed the special advisory on consumption of Torch Lake fish in 1993. The contaminants still present in Torch Lake fish are not thought to be connected to the contamination at the Torch Lake site. A person eating more than one 0.5-pound meal of fish from the lake every 2 months might ingest enough mercury to exceed the Minimal Risk Limit (MRL) for acute oral exposure to organic mercury established by the ATSDR (18). People eating fish from the lake are not likely to ingest enough of the other chemicals present exceed MRLs for non-cancer adverse health effects or to incur more than a low increased risk of contracting cancer.

B. Community Health Concerns

Residents of the Torch Lake vicinity have expressed concerns about the site, generally regarding the possibility of exposure to the site contaminants and the adverse health effects that might result from the exposure. Health authorities have not recently heard any concerns about any perceived occurrence of adverse health effects (19).

CONCLUSIONS

The Preliminary Health Assessment for the site concluded that the site was "of potential public health concern" because of the possibility of exposure to "presently unknown etiologic agents" that were responsible for the tumors in the fish living in the lake. These agents have still not been identified, however, more recent investigation of the fish has not found any unusual occurrence of tumors.

The results of recent investigations of the site indicate that the site poses a public health hazard because of the possibility of human exposure to tailings and surface soil containing copper, other metals, and polycyclic aromatic hydrocarbons at concentrations potentially of human health concern.

RECOMMENDATIONS

A. Status of Previous ATSDR Recommendations

The Preliminary Health Assessment for the site included recommendations for further site investigation, specifically of the barrels that were found in the lake, private wells near the lake, and fish in the lake (10). The RIs for the various Operable Units at the site collected extensive data on contamination of environmental media between 1989 and 1991 (1, 3, 4, 5, 6). Drummed wastes found in and near Torch Lake were sampled for analysis in several rounds in 1989, 1990, and 1991, before the drums were removed for off-site disposal in August and September 1991 (1, 7). The RI for Operable Unit II included groundwater sampling from monitoring, residential, and municipal wells between July 1989 and October 1991 (1, 3, 16).

The MDNR investigated the fish in Torch Lake in 1988, and concluded that there was no sign that they continued to suffer from the tumors that had been seen earlier. In 1993, the MDPH retracted the special fish consumption advisory on Torch Lake, though the generic advisory on consumption of fish from any inland lake or reservoir in Michigan because of mercury content remains in effect.

A contractor for a group of PRPs for the site removed more than 100 drums from the lake and the shore in August and September 1991. Additionally, the RI report says, "In Hubbell and Lake Linden, debris around the smelters and from the shoreline have been removed." (Reference 1, p. 1-8.) No further information is provided as to the date and extent of this removal. A local observer reports that not all debris from the smelter operation has been removed (12).

B. New Recommendations

There has been extensive investigation of environmental media this site since the Preliminary Health Assessment. The additional data developed in these investigations should be evaluated in a full Public Health Assessment.

C. Health Activities Recommendation Panel Statement

The data and information developed in the Torch Lake Site Review and Update have been evaluated to determine if follow-up actions may be indicated. Further site evaluation is needed to determine appropriate public health actions. There is cause to believe that people living near the site are exposed to copper, other metals, and PAHs at levels of health concern. However, the data have not been analyzed sufficiently to determine whether follow-up health activities are needed. A full Public Health Assessment for the site should be done, and a HARP convened to evaluate the data, information, and analyses.

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2. Michigan Department of Public Health. Fish Consumption Advisory. In Michigan Department of Natural Resources, 1994 Michigan Fishing Guide, pp. 25-29. March 1994.

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7. Geraghty and Miller, Inc. Final Drum Removal Report, Torch Lake Drum Removal, Houghton County, Michigan. March 24, 1992.

8. U.S. Environmental Protection Agency. Record of Decision for Torch Lake Site, Operable Units I and III. September 30, 1992.

9. Kunze, J., U.S. EPA. Personal Communication. April 26, 1994.

10. Michigan Department of Public Health, for ATSDR. Preliminary Health Assessment for Torch Lake, Houghton County, Michigan. April 14, 1989.

11. Hesse, J., MDPH. Memorandum to L. Fabinski, ATSDR. Subject: Consultation on Torch Lake NPL Site. April 18, 1990.

12. Rowe, K., MDPH and Western Upper Peninsula Health Department, ret. Personal Communication. July 28, 1994.

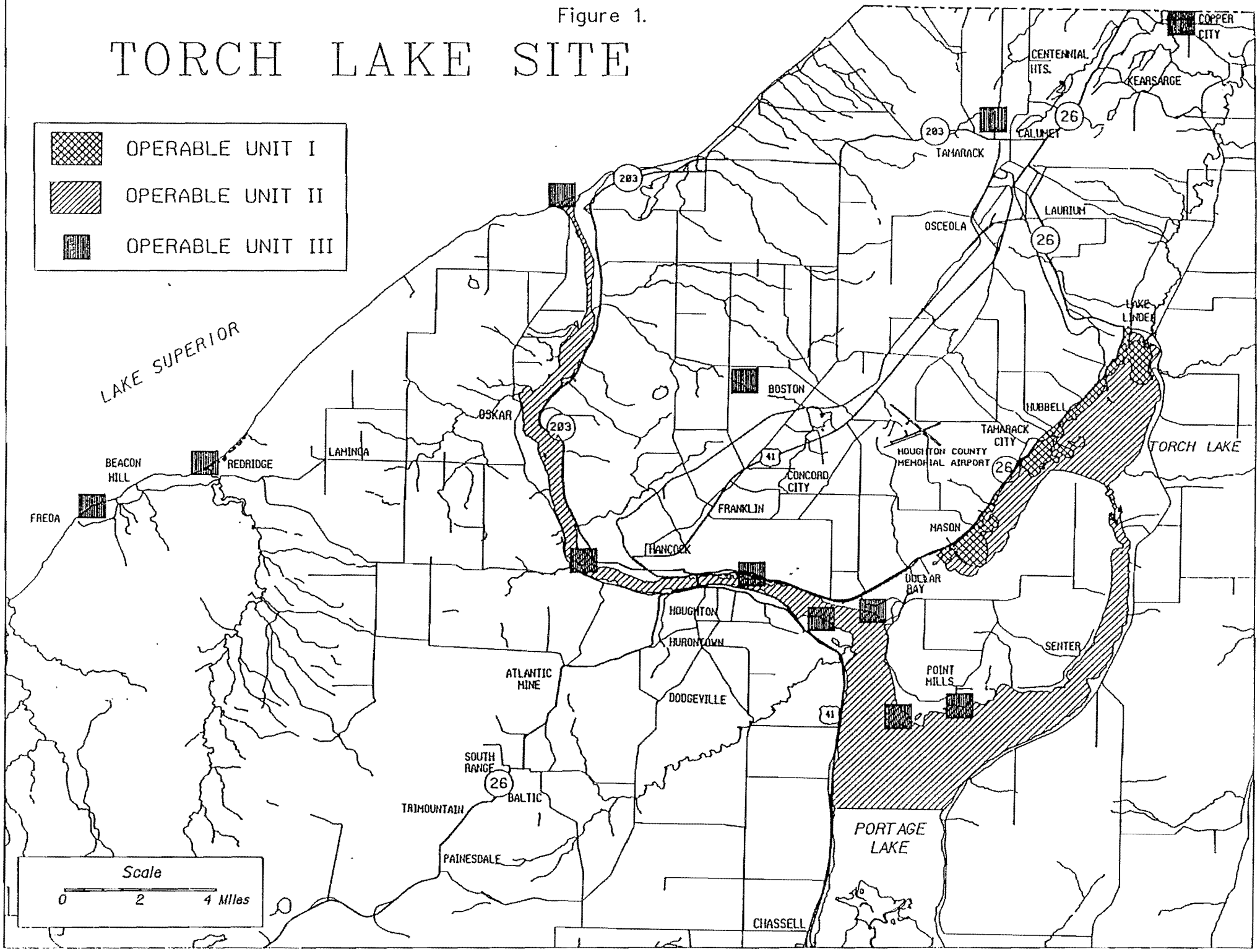
APPENDIX A.

FIGURES

LIST OF FIGURES

Figure 1.

TORCH LAKE SITE



APPENDIX B.

TABLES

LIST OF TABLES

Table 1. Concentrations of contaminants of concern from surface samples of Torch Lake tailings, from the RI (1989)

Chemical	Maximum Concentration (ppm)	Comparison Value (ppm)
acenaphthylene	0.037J	NA
antimony	11.7	0.8[R]
arsenic	118	0.6[B]; 0.4[C]
barium	392	100[R]
benzo(a)anthracene	0.27J	carcinogen
benzo(a)pyrene	0.27J	0.1[C]
benzo(b)fluoranthene	0.56	carcinogen
benzo(g,h,i)perylene	0.24J	carcinogen
benzo(k)fluoranthene	0.56	carcinogen
beryllium	1.7	0.2[C]
chromium	649	2,000[R] (III) carcinogen (VI)
chrysene	0.41	carcinogen
cobalt	52.6	NA
copper	12,800	NA
dibenzo(a,h)anthracene	0.079J	carcinogen
dibenzofuran	0.074J	NA
indeno(1,2,3-cd)pyrene	0.22J	carcinogen
lead	113	carcinogen
manganese	1,080	10[R]
mercury	1.1	NA
2-methylnaphthalene	0.24J	NA
naphthalene	0.17J	NA
nickel	57.3	carcinogen
phenanthrene	0.27J	NA
silver	8.2	10[R]
vanadium	159	NA
zinc	780	600[R]

Reference: 1

Only chemicals that were detected are listed

Shaded chemicals exceed comparison values

J — Estimated Value

(III)— For chromium(III)
(VI)— For chromium(VI)

NA — Not Available
carcinogen — Carcinogen (known, probable, or possible) but no CREG available

Comparison Value Bases

E — ATSDR Environmental Media Evaluation Guides (EMEGs)
R — ATSDR Reference Dose Media Evaluation Guides (RMEGs), calculated from U.S. EPA Reference Dose, assuming child ingestion
C — ATSDR Cancer Risk Evaluation Guides (CREGs), for 1×10^{-6} estimated excess cancer risk (a significant additional risk of developing cancer is taken to be one additional case of cancer in a population of 1 million people experiencing the exposure)

Table 2. Concentrations of contaminants of concern from surface samples of tailings from Operable Unit III sites near Torch Lake, from the RI (1990)

Chemical	Maximum Concentration (ppm)	Comparison Value (ppm)
antimony	164	0.8[R]
arsenic	37.8	0.6[E]; 0.4[C]
barium	645	100[R]
benzo(b)fluoranthene	0.07J	carcinogen
benzo(k)fluoranthene	0.07J	carcinogen
beryllium	2.2	0.2[C]
cadmium	13.9	1[E], carcinogen
chromium	745	2,000[R] (III) carcinogen (VI)
chrysene	0.07J	carcinogen
cobalt	67.9	NA
copper	13,500	NA
lead	63.7	carcinogen
manganese	1,640	10[R]
mercury	0.21	NA
nickel	149	carcinogen
silver	52.3	10[R]
vanadium	197	NA
zinc	205	600[R]

Reference: 4

Only chemicals that were detected are listed

Shaded chemicals exceed comparison values

J — Estimated Value

(III)— For chromium(III)
(VI)— For chromium(VI)

NA — Not Available
carcinogen — Carcinogen (known, probable, or possible) but no CREG available

Comparison Value Bases

E — ATSDR Environmental Media Evaluation Guides (EMEGs)
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Table 3. Concentrations of contaminants of concern from surface soil samples collected in residential areas near Torch Lake during the RI (1989)

Chemical	Maximum Concentration (ppm)	Comparison Value (ppm)
acenaphthylene	0.15J	NA
arsenic	7	0.6[E], 0.4[C]
barium	101	100[R]
benzo(a)anthracene	1.5	carcinogen
benzo(a)pyrene	1.6	0.1[C]
benzo(b)fluoranthene	1.5	carcinogen
benzo(g,h,i)perylene	0.67J	carcinogen
benzo(k)fluoranthene	0.67J	carcinogen
cadmium	1.4	1[E], carcinogen
chromium	20.1	2,000[R] (III) carcinogen (VI)
chrysene	1.6	carcinogen
copper	459	NA
dibenzo(a,h)anthracene	0.29J	carcinogen
indeno(1,2,3-cd)pyrene	0.63J	carcinogen
lead	329	carcinogen
manganese	357	10[R]
mercury	0.47	NA
2-methylnaphthalene	0.054J	NA
naphthalene	0.071J	NA
nickel	33.7	carcinogen
phenanthrene	1.9	NA
vanadium	26.3	NA
zinc	146	600[R]

Reference: 1

Only detected chemicals are listed

Shaded chemicals exceed comparison values

Table 6. Concentrations of contaminants in fish from Torch Lake, 1988

Chemical	Maximum Concentration (ppm)			MDPH Level of Concern[1] (ppm)
	Northern Pike	Smallmouth Bass	Walleye	
mercury	0.32	0.67	0.33	0.5
PCBs	0.106	0.138	0.081	2.0
trans-nonachlor	ND (0.003)	ND (0.003)	0.003	0.3[2]
4,4'-DDE	0.019	0.029	0.019	5.0[3]

Reference: 14

Only chemicals that were detected are listed

1. Based on U.S. FDA Action Levels, except for mercury (FDA Action Level = 1.0 ppm)

2. For total chlordane isomers.

3. For total DDT and metabolites.

Table 5. Concentrations of contaminants of concern found in water samples from residential and municipal wells near Torch Lake

Chemical	Date	Maximum Concentration (ppb)	Reference	Comparison Value (ppb)
arsenic	11/90	2.5J	3	3[R], 0.02[C]
	10/91	4.5J	16	
barium	7/89	250	1	700[A]
	11/90	262	3	
	10/91	145	16	
copper	7/89	31	1	1,300[MG]
	11/90	1,320	3	
	10/91	154	16	
4,4'-DDD	9/90	0.13	3	0.1[C]
4,4'-DDT	9/90	0.28J	3	0.1[C]
lead	7/89	9.2	1	15[PL], carcinogen
	11/90	ND (1.0)	3	
	10/91	ND (1.0)	16	
manganese	11/90	71.3	3	50[R]
	10/91	137	16	
thallium	11/90	ND (1.0)	3	0.4[A]
	10/91	1.1J	16	
vanadium	7/89	18	1	NA
	11/90	11.9	3	
	10/91	ND (7.0)	16	
zinc	7/89	1,100	1	3,000[R]
	11/90	1,530	3	
	10/91	31.J	16	

Only chemicals that were detected are listed
Shaded chemicals exceed comparison values.
ND — Not Detected (with detection limit)
J — Estimated Value
NA — None Available
carcinogen — Carcinogen (proven, probable, or possible) but no CREG available

Comparison Value Bases
E — ATSDR Environmental Media Evaluation Guides (EMEGs)
R — ATSDR Reference Dose Media Evaluation Guides (RMEGs), calculated from U.S. EPA Reference Dose, assuming child ingestion
A — U.S. EPA Drinking Water Health Advisory (Lifetime)
MG— U.S. EPA Safe Drinking Water Act Maximum Contaminant Level Goal
PL— U.S. EPA Proposed Action Level for Lead in Drinking Water
C — ATSDR Cancer Risk Evaluation Guides (CREGs), for 1 x 10^{-6} estimated excess cancer risk (a significant additional risk of developing cancer is taken to be one additional case of cancer in a population of 1 million people experiencing the exposure)

Table 4. Concentrations of contaminants of concern found in water samples from monitoring wells near Torch Lake, from the OU II RI, November 1990

Chemical	Maximum Concentration (ppb)				Comparison Value (ppb)
	shallow		deep		
	total	dissolved	total	dissolved	
antimony	31J	ND (24.0)	ND (24.0)	ND (24.0)	4[R]
arsenic	24.9	25.2	ND (2.0)	ND (2.0)	3[A], 0.02[C]
barium	1,320	1,280	209	206	700[R]
chromium	119	8J	10.5	ND (6.0)	10,000[R] (III) carcinogen (VI)
copper	6,150	583	10.1J	3.3J	1,300[MG]
lead	39	10.9	5.5J	2.3J	15[PL], carcinogen
manganese	3,730	3,640	90.3	88.2	50[A]
nickel	131	9.2J	6.5J	ND (6.0)	carcinogen
vanadium	341	13.7J	ND (3.0)	ND (3.0)	NA
zinc	438	22.J	755	48.9	3,000[R]

Reference: 3

Only chemicals that were detected are listed

Shaded chemicals exceed comparison values.

ND — Not Detected (with detection limit)
J — Estimated Value

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Comparison Value Bases

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R — ATSDR Reference Dose Media Evaluation Guides (RMEGs), calculated from U.S. EPA Reference Dose, assuming child ingestion
A — U.S. EPA Drinking Water Health Advisory (Lifetime)
MG— U.S. EPA Safe Drinking Water Act Maximum Contaminant Level Goal
PL— U.S. EPA Proposed Action Level for Lead in Drinking Water
C — ATSDR Cancer Risk Evaluation Guides (CREGs), for 1 x 10^{-6} estimated excess cancer risk (a significant additional risk of developing cancer is taken to be one additional case of cancer in a population of 1 million people experiencing the exposure)

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C — ATSDR Cancer Risk Evaluation Guides (CREGs), for 1 x 10^{-6} estimated excess cancer risk (a significant additional risk of developing cancer is taken to be one additional case of cancer in a population of 1 million people experiencing the exposure)